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EFFECTS OF ORGANIC MANURE, MINERAL NITROGEN AND BIO-FERTILIZER APPLICATION ON VEGETATIVE GROWTH AND CHEMICAL COMPOSITION OF PEA (*PISUM SATIVUM* L.)

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ABSTRACT: Two field experiments were conducted at the Experimental Station Farm (at Abies), Faculty of Agriculture, Alexandria University, during the two winter seasons of 1999/2000 and 2000/2001. The objective of this investigation was to study the effects of two organic fertilizer rates (0 and 25 m^3 fad.$^{-1}$), three inorganic nitrogen levels (0, 20 and 40 kg N fad.$^{-1}$) and two biofertilization treatments (inoculation with and without bacteria of genus *Rhizobium*), and their combination treatments on some vegetative growth characters and chemical composition of pea (*Pisum sativum* L.). The obtained results indicated that application of cattle manure at the rate of 25 m^3 fad.$^{-1}$ increased, significantly, all vegetative growth characters; plant height, number of leaves and branches plant^{-1}, and fresh and dry mass plant^{-1}; in both seasons. Application of nitrogen at the rate of 20 kg N fad.$^{-1}$ and *Rhizobium* inoculation gave the best, significant, mean values of most studied characters. The interactions of organic manure by mineral nitrogen, organic manure by biofertilizer and mineral nitrogen by *Rhizobium* inoculation reflected significant influences on all the studied vegetative growth characters. The most favourable combination treatments were 25 m^3 cattle manure fad.$^{-1}$ + 20 kg N fad.$^{-1}$, 25 m^3 cattle manure fad.$^{-1}$ + *Rhizobium* inoculation and 20 kg N fad.$^{-1}$ + *Rhizobium* inoculation. Moreover, application of organic manure at the rate of 25m^3fad.$^{-1}$ + 20 kg N fad.$^{-1}$ + *Rhizobium* inoculation was the best second-order interaction treatment for all vegetative growth parameters. Generally, the N, P and K concentrations of pea leaves were significantly affected by nitrogen fertilizer applications.

Whereas, each of organic manure and *Rhizobium* inoculation did not reflect any significant effect on the contents of N, P and K in pea leaves. Also, all the interaction treatments had no significant effect on the percentages of N, P and K contents of pea leaves.

INTRODUCTION

Pea (*Pisum sativum* L.) is one of the most popular vegetable crops grown successfully in Egypt. It had a high nutritional value due to its high contents of protein, minerals and vitamins. Due to the progressive increments in fresh local consumption and processing demands as a result of continuous increases in population number, efforts for increasing the productivity and improving the quality of pea must be given a great attention.

Nitrogen fertilization is of a great importance in the production of pea. The biological fixation of atmospheric nitrogen by pea plants through the symbiotic action of nitrogen-fixing bacteria may be sufficient to meet the plant's needs or not. Nitrogen fertilizer was found to have stimulative effects on root growth of many legume crops as reported by many investigators (Cebula *et al.*, 1987; Rai and Alipit, 1989; Swidan, 1995). The excessive use of nitrogen fertilizer leads to an environmental pollution (Hartman, 1988). In addition, the inorganic N fertilizers represent the major coast of crop production. Under these circumstances, supplementing or substitution of inorganic N fertilizers with organic sources, such as those of microbial origin, is needed (Barakat and Gabr, 1998).

Organic fertilizer, such as cattle manure, is considered as an important source of humus, macro- and micro-elements carrier, and at the same time increase the activity of the useful micro-organisms (El-Gizy, 1994). Many authors documented favourable effects of organic manures on plant growth. The addition of organic fertilizers improves the soil structure which can encourage root development and leads to better growth (Soliman *et al.*, 1991; Singer *et al.*, 1998; Tarkalson *et al.*, 1998). Maintaining soil fertility and productivity level could be achieved through periodic addition of proper organic materials in combination with inorganic fertilizers (Abd El-Latif and Abdel Fattah, 1983; Sakr *et al.*, 1992). Also, Ibrahim *et al.*

(1986) concluded that organic materials increased the efficiency of inorganic fertilizers, particularly, in the long term.

The use of biofertilizer containing the symbiotic N-fixing bacteria of genus Rhizobium, is of a great agricultural importance for legumes production (Abd El-Naby, 1998; Arisha *et al.*, 1998; Merghany, 1999; Abd El-Ati et al., 2000). Dealing with the effects of bacterial inoculation, Sundstorn *et al.* (1982) clarified that N-fixation was the greatest with 25 kg N ha^{-1} applied at sowing time followed by bacterial inoculation after 21 days of sowing.

Thus, the major objective of this research was to study the main effects and interactions of organic manure, inorganic nitrogen fertilizer and Rhizobium inoculation on vegetative growth characters of pea plants.

MATERIALS AND METHODS

During the two consecutive winter seasons of 1999/2000 and 2000/2001, two field trials were carried out at the Experimental Station Farm (at Abies), of the Faculty of Agriculture, Alexandria University. The goal of these trials was to study the effects of fertilization with organic manure, inorganic nitrogen fertilizer and Rhizobium inoculation on pea plants.

Each experiment comprised 12 treatments represent all possible combinations of two organic fertilizer rates (0 and 25 m^3. $fad.^{-1}$), three inorganic N fertilizer levels (0, 20 and 40 kg N $fad.^{-1}$) and two seed inoculation treatments (with or without a biofertilizer containing the symbiotic N-fixing bacteria of genus Rhizobium). Cattle manure and ammonium nitrates 33.5% were the respective sources of the organic and mineral fertilizers, consecutively.

Prior to the initiation of each experiment, soil samples were collected and analyzed according to the published methods (Page *et al.*, 1982). Results of the analysis are given in Table 1. The chemical properties of the used cattle manure are presented in Table 2.

The experimental layout was split-split plot in a randomized complete blocks design with three replications. Organic manure treatments were arranged as the main plots, nitrogen rates were considered as the sub-plots and seed inoculation treatments were taken as sub-sub plots. Each sub-sub plot consisted of three rows 4 m long and 70 cm wide. The cattle

Table 1. Physical and chemical properties of the experimental site, during the winter seasons of 1999/2000 and 2000/2001

Properties / Seasons	Physical				Chemical					
	Sand (%)	Silt (%)	Clay (%)	Texture	pH	E.C. ($ds.m^{-1}$)	N (%)	P (p.p.m)	K ($meql^{-1}$)	O.M. (%)
1999/2000	44.59	16.81	38.60	Clay-loam	7.8	3.34	0.13	12	0.05	1.27
2000/2001	42.48	14.34	43.10	Clay-loam	7.83	2.56	0.14	13	0.05	2.62

Table 2. Chemical properties of the cattle manure during the winter seasons of 1999/2000 and 2000/2001

Properties / Seasons	N (%)	P (%)	K (%)	pH	O.M (%)
1999/2000	0.98	0.49	0.98	8.08	15.75
2000/2001	0.60	0.39	1.21	8.02	18.25

manure was incorporated into the soil before seed sowing. Seeds of pea cv. "Master" were inoculated with the symbiotic N-fixing bacteria of genus *Rhizobium* and were directly planted after inoculation on one side of the rows at 20 cm apart on Nov. 19, 1999 and Oct. 19, 2000. The mineral N fertilizer was banded at two equal portions; 25 and 35 days after seed sowing. During the growing seasons, all other recommended agromanagements were followed. In each sub-sub plot, five plants, after 70 days of seed sowing, were randomly chosen from the outer two rows to measure the following characters; plant height, number of leaves and branches $plant^{-1}$, fresh and dry masses $plant^{-1}$ and nutrient contents of leaves. One hundred of leaves were collected after 70 days of seed sowing, washed with distilled water, dried at 70 C, ground and digested using hydrogen peroxide and sulphoric acid. Concentrations of N, P and K were determined as outlined in FAO (1980).

Appropriate analysis of variance on results of each experiment was performed (Costat Software, 1985). Comparisons among the means of different treatments were undertaken using the revised L.S.D. procedure at $p = 0.05$ level as illustrated by Smith (1978).

RESULTS AND DISCUSSIONS

The results of the main effects of organic manure, mineral nitrogen and *Rhizobium* inoculation on vegetative growth characters of pea plants are shown in Table 3. Application of cattle manure at the rate of 25 m^3 $fad.^{-1}$ significantly increased all the studied vegetative growth characters, compared to control, in both growing seasons. Increasing the morphological characters of pea plants, after organic manure application may be due to increasing the soil organic matter content, cation exchange capacity and mineral nutrients, which in turn encouraged the plant growth to go forward. El-Mansi *et al.* (1999), emphasized the importance of addition organic manure to sandy soils, which can result in improving their physio-chemical and biological properties. The previous mentioned results were in general accordance with those reported by many researchers (Soliman *et al.*, 1991; El-Gizy, 1994; Gendy *et al.*, 1994).

The application of inorganic N fertilizer to the grown pea plants, irrespective of the amounts used, significantly, gave longer plants, more number of leaves, and branches $plant^{-1}$ and attained heavier fresh and dry masses

Table 3. The main effects of organic manure, mineral nitrogen and biofertilizer inoculation treatments on vegetative growth characters of pea plants, during the two winter seasons of 1999/2000 and 2000/2001

Seasons	1999/2000					2000/2001				
Treatments	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	Fresh mass plant^{-1} (g)	Dry mass plant^{-1} (g)	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	Fresh mass (g)	Dry mass (g)
[X]Organic manure rates										
O_0	63.41* B	19.08 B	1.80 B	51.67 B	6.94 B	69.02 B	20.95 B	1.77 B	51.18 B	6.55 B
O_1	71.54 A	23.04 A	2.58 A	62.11 A	8.09 A	75.93 A	26.33 A	2.02 A	62.89 A	7.34 A
[Y]Mineral nitrogen rates										
N_0	60.32 C	18.48 C	1.71 C	49.58 B	6.58 C	66.20 C	19.72 C	1.68 B	47.66 C	6.25 C
N_1	72.67 A	23.66 A	2.52 A	61.93 A	8.22 A	78.55 A	26.58 A	2.03 A	63.56 A	7.43 A
N_2	69.45 B	21.03 B	2.33 B	59.29 A	7.74 B	72.67 B	24.62 B	1.98 A	59.87 B	7.16 B
[Z]Biofertilizer inoculation										
B_0	66.15 B	20.68 A	2.15 B	55.78 B	7.29 A	70.36 B	22.60 B	1.85 B	55.73 B	6.87 B
B_1	68.81 A	21.44 A	2.23 A	58.09 A	7.74 A	74.58 A	24.69 A	1.94 A	58.33 A	7.03 A

* Values followed by the same letter (s), within a comparable group of means of the main effects, are not significantly different, using revised L.S.D. test at 0.05 level.

X Organic manure rates (m^3 fad.$^{-1}$) : O_0 = without organic manure (control) and O_1 = 25.

Y Mineral nitrogen rates (kg N fad.$^{-1}$) : N_0 = without nitrogen (control), N_1 = 20 and N_2 = 40.

Z Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium*.

plant[1], compared with those of the control (without N), in both seasons(Table 3). The application of 20 kg N fad.$^{-1}$ gave, significantly, higher mean values for plant height, number of leaves plant^{-1} and dry mass plant^{-1}, than the addition of 40kg N fad.$^{-1}$, in both seasons. The same influence on number of branches plant^{-1}, in the first season, and fresh mass plant^{-1}, in the second season, was obvious. The stimulation effects of applying nitrogen on vegetative growth characters of pea plants may be attributed to the well known functions of nitrogen in plant life. Being a part of protein, it is an important constituent of protoplasm. Also, enzymes, the biological catalytic agents, which speed up life processes, have N as their major constituents. Moreover, nitrogen involves in many organic compounds of plant system. A sufficient supply of various nitrogenous compounds is, therefore, required in each plant cell for its proper functioning (Mengel and Kirkby, 1987). These results agree with those reported by El-Hamdi *et al.* (1992), Abou-El-Hassan *et al.* (1993), Swidan (1995), Abd-El-Naby (1998), and Arisha and Bardisi (1999).

Concerning the effects of *Rhizobium* inoculation on vegetative growth characters of pea plants, data in Table 3 show that, in 1999/2000 season, Rhizobium inoculation treatment, significantly, increased plant height, number of branches plant^{-1} and fresh mass plant^{-1} compared to the uninoculated control; whereas, no significant effects on number of leaves plant^{-1} and dry mass plant^{-1} were detected. In 2000/2001 season, the mean values for all the studied vegetative growth characters of inoculated pea plants were, significantly, higher than those of the uninoculated control. Results obtained by many investigators seemed to confirm the obtained findings (Hassan *et al.*, 1993; Abd El-Naby, 1998; Merghany, 1999). Whereas, El-Oksh *et al.* (1991) reported that, the bacterial inoculation of seeds or seedlings showed very slight effects on plant growth of common bean. Merghany (1999) mentioned also that the increase in plant growth may be attributed to the ability of *Rhizobium* to form nodules.

Data in Table 4 illustrate the effects of the first-order interactions (organic manure x mineral nitrogen, organic manure x biofertilizer and mineral nitrogen x

Table 4. The first-order interaction effects of among organic manure, mineral nitrogen and biofertilizer inoculation treatments on vegetative growth characters of pea plants, during the two winter seasons of 1999/2000 and 2000/2001

Seasons	1999/2000					2000/2001				
Treatments	Plant Height (cm)	No. of leaves $plant^{-1}$	No. of branches $plant^{-1}$	Fresh mass $plant^{-1}$ (g)	Dry mass $plant^{-1}$ (g)	Plant Height (cm)	No. of leaves $plant^{-1}$	No. of branches $plant^{-1}$	Fresh mass $plant^{-1}$ (g)	Dry mass $plant^{-1}$ (g)
X Organic x nitrogen										
$O_o + N_o$	55.96* e	17.16 c	1.51 c	47.48 d	6.36 c	62.28 d	18.14 d	1.56 d	42.36 e	5.97 e
$O_o + N_1$	66.96 cd	20.06 b	1.95 b	53.87 c	7.19 bc	72.81 bc	22.95 c	1.89 bc	55.29 c	6.84 c
$O_o + N_2$	67.33 c	20.00 b	1.94 b	53.92 c	7.26 bc	71.98 bc	21.76 c	1.86 bc	55.87 c	6.85 c
$O_1 + N_o$	64.69 d	19.81 b	1.92 b	51.68 cd	6.80 c	70.13 c	21.30 c	1.80 c	52.97 d	6.52 d
$O_1 + N_1$	78.37 a	27.27 a	3.08 a	69.99 a	9.24 a	84.28 a	30.22 a	2.17 a	71.83 a	8.03 a
$O_1 + N_2$	71.58 b	22.05 b	2.73 a	64.66 b	8.23 ab	73.37 b	27.48 b	2.09 ab	63.87 b	7.47 b
Y Organic x biofertilizer										
$O_o + B_o$	61.49 c	18.75 b	1.73 b	49.31 c	6.58 c	66.48 d	19.34 c	1.69 b	49.90 d	6.39 c
$O_0 + B_1$	65.34 b	19.40 b	1.87 b	54.20 b	7.29 b	71.57 c	22.56 b	1.85 ab	52.45 c	6.71 b
$O_1 + B_0$	70.82 a	22.60 a	2.56 a	62.25 a	8.00 a	74.25 b	25.86 a	2.01 a	61.56 b	7.34 a
$O_1 + B_1$	72.27 a	23.48 a	2.59 a	61.98 a	8.18 a	77.60 a	26.81 a	2.03 a	64.22 a	7.34 a
Z Nitrogen x biofertilizer										
$N_o + B_o$	58.15 d	18.07 d	1.64 c	48.13 c	6.50 c	64.23 d	18.35 d	1.61 b	45.83 d	6.03 e
$N_o + B_1$	62.49 c	18.89 cd	1.79 c	51.03 c	6.66 c	68.18 c	21.09 c	1.75 b	49.50 c	6.46 d
$N_1 + B_0$	70.37 b	22.38 b	2.45 ab	59.28 b	7.78 ab	76.93 b	24.75 b	1.96 a	60.72 b	7.28 b
$N_1 + B_1$	74.96 a	24.94 a	2.59 a	64.58 a	8.65 a	80.16 a	28.42 a	2.09 a	66.40 a	7.58 a
$N_2 + B_0$	69.93 b	21.57 b	2.36 ab	59.93 b	7.60 b	69.93 c	24.68 b	1.98 a	60.65 b	7.29 b
$N_2 + B_1$	68.96 b	20.48 bc	2.31 b	58.65 b	7.89 ab	75.42 b	24.56 b	1.97 a	59.09 b	7.04 c

*Values followed by the same letter (s), within a comparable group of means of the main effects, are not significantly different, using revised L.S.D. test at 0.05 level.

X Organic manure rates (m^3 $fad.^{-1}$) : O_0 = without organic manure (control) and O_1 = 25.
Y Mineral nitrogen rates (kg N $fad.^{-1}$) : N_0 = without nitrogen (control) , N_1 = 20 and N_2 = 40.
Z Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium* .

biofertilizer) on the vegetative growth characters of pea plants.

The effect of interactions between the different rates of organic manure and mineral nitrogen on the studied vegetative characters of pea plants were found significant, in both winter seasons. The application of mineral nitrogen at the rate of 20 kg N fad.$^{-1}$, combined with the application of cattle manure at the rate of 25 m^3 fad.$^{-1}$, resulted in the highest significant mean values for all the studied vegetative parameters, in both years. This result illustrated that using organic manure had a beneficial influence on reducing the amount of mineral nitrogen. This may be due that organic manure can offer enough nitrogen to micro-organisms that are living in the soil, which convert the nutrients form unavailable to available form for plants (Abou-Hussein, 2001).

Concerning the interaction effects between organic fertilization and seed inoculation with *Rhizobium*, the results in Table 4 exhibited significant differences, within each studied character, in both seasons. Comparisons among the mean values of the different treatment combinations indicated that, whether the pea seeds were inoculated with or without *Rhizobium* inoculant, values of all the studied vegetative parameters were, significantly, higher with than without organic fertilization. At 25 m^3 organic manure fad.$^{-1}$, values of all the studied growth parameters were similar whether pea seeds were inoculated with or without *Rhizobium* inoculant. The exception was in the case of plant height and fresh mass plant^{-1} in the 2nd season as they were significantly higher with than without *Rhizobium* inoculation. The previous results can be discussed on the basis that the inoculated plants might have the ability to produce phytohormons as IAA, CYT and GA with an eventual increase in vegetative growth (Frankenberger and Arshad, 1995; El-Mansi *et al.*, 1999). Scow *et al.* (1994) reported that application of FYM to soils increased the microbial biomass and stimulated plant growth.

It is clear from data in Table 4 that the interaction between mineral nitrogen and *Rhizobium* inoculation, significantly, affected all the vegetative growth characters of pea plants, in both years. The optimum interactive treatment was 20 kg N fad.$^{-1}$ + *Rhizobium* inoculation. On the other hand, the combination treatment between 40 kg N fad.$^{-1}$ + *Rhizobium* inoculation appeared to have reducing effects on the behaviour of all the vegetative growth characters, in both seasons. This effect could be due to that, biofertilizer inoculation plays a fundamental role in converting organic form of nutrients such as nitrogen to mineral nitrogen .

Data presented in Table 5 indicate the second-order interactions among organic manure, mineral nitrogen and biofertilizer treatments. The differences among the mean values of the treatment combinations for the studied characters, were high enough to be significant in most cases, in both growing seasons. The best interaction treatment was obtained by using organic manure at the rate of 25 m^3. fad.$^{-1}$, combined with 20 kg N fad. $^{-1}$ and *Rhizobium* inoculation, which resulted in the highest mean values of all vegetative growth parameters, in the two growing seasons of 1999/ 2000 and 2000/2001.

Data presented in Table 6 illustrate the nutrient contents of pea leaves expressed as N, P and K percentages. The results, clearly, indicated that the addition of organic manure did not reflect any significant effect on the N, P and K concentrations of pea leaves, in both years. These results did not agree with those reported by Fayed (1998), who indicated that the addition of chicken manure to soil increased N and P contents in plants.

Generally, the results presented in Table 6 show that the N, P and K concentrations of pea leaves were, significantly, affected by nitrogen fertilizer applications. The highest percentages of these contents were noticed in plants received 20 kg N fad.$^{-1}$, in both seasons. Similar findings were obtained by Almeida *et al.* (1988), who reported that the N content of all plant parts increased with increasing N rates. The previous mentioned results are in agreement with those reported by Shafshak (1991) and Merghany (1999).

Results in Table 6 show no significant effect for *Rhizobium* inoculation on the concentrations of N, P and K in pea leaves, in both seasons. These results were in line with those reported by Arisha *et al.* (1998), who found that the contents of P and K in pea leaves did not respond significantly to

Table 5: The second-order interaction effects of among organic manure, mineral nitrogen and biofertilizer inoculation treatments on vegetative growth characters of pea plants, during the two winter seasons of 1999/2000 and 2000/2001

Seasons	1999/2000					2000/2001				
Treatment combinations	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	Fresh mass plant^{-1} (g)	Dry mass plant^{-1} (g)	Plant height (cm)	No. of leaves plant^{-1}	No. of branches plant^{-1}	Fresh mass plant^{-1} (g)	Dry mass plant^{-1} (g)
^{X}Organic x ^{Y}Nitrogen x ^{Z}Biofertilizer										
$O_o + N_o + B_o$	53.43* f	16.67 d	1.42 c	46.10 e	6.35 c	59.94 c	16.61 f	1.50 c	41.92 g	5.84 c
$O_o + N_0 + B_1$	58.49 ef	17.66 d	1.60 c	48.85 de	6.36 c	64.61 de	19.67ef	1.63 bc	42.80 g	6.10 c
$O_o + N_1 + B_o$	64.24 dc	19.54 cd	1.86 c	49.47 de	6.51 c	69.09 cd	20.57ef	1.77 a-c	52.41 ef	6.64 b
$O_o + N_1 + B_1$	69.68 b-d	20.58 cd	2.04 bc	58.27 b-d	7.88 a-c	76.53 b	25.33 b-d	2.00 a-c	58.18 d	7.04 b
$O_o + N_2 + B_o$	66.79 cd	20.04 cd	1.92 bc	52.37 c-e	6.89 bc	70.40 b-d	20.83d-f	1.81 a-c	55.38 de	6.70 b
$O_o + N_2 + B_1$	67.85 cd	19.97 cd	1.96 bc	55.47 c-e	7.62 a-c	73.56 bc	22.69 c-e	1.91 a-c	6.37 d	7.01 b
$O_1 + N_o + B_o$	62.87 de	19.48 cd	1.86 c	50.16 de	6.65 c	68.51 cd	20.10ef	1.73 a-c	49.73 f	6.23 c
$O_1 + N_0 + B_1$	66.50 cd	20.13 cd	1.98 bc	53.20 c-e	6.96 bc	71.75 bc	22.51 c-e	1.87 a-c	56.20 d	6.82 b
$O_1 + N_1 + B_o$	76.50 ab	25.23 b	3.03 a	69.10 a	9.06 ab	84.18 a	28.93 ab	2.15 a	69.03 b	7.92 a
$O_1 + N_1 + B_1$	80.24 a	29.31 a	3.14 a	70.90 a	9.43 a	84.28 a	31.50 a	2.19 a	74.63 a	8.13 a
$O_1 + N_2 + B_o$	73.08 a-c	23.10 bc	2.80 a	67.49 ab	8.30 a-c	69.46 cd	28.53 ab	2.14 a	65.92 b	7.87 a
$O_1 + N_2 + B_1$	70.08 b-d	20.99 cd	2.65 ab	61.84 a-c	8.16 a-c	77.28 b	26.43 bc	2.04 ab	61.82 c	7.08 b

* Values followed by the same letter (s), within a comparable group of means of the main effects, are not significantly different, using revised L.S.D. test at 0.05 level.

^{X} Organic manure rates (m^3 fad.$^{-1}$) : O_0 = without organic manure (control) and O_1 = 25.
^{Y} Mineral nitrogen rates (kg N fad.$^{-1}$) : N_0 = without nitrogen (control), N_1 = 20 and N_2 = 40.
^{Z} Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium*.

Table 6. Mineral contents of N, P and K (%) in pea leaves as influenced by organic manure, mineral nitrogen and biofertilizer inoculation treatments, during the two winter seasons of 1999/2000 and 2000/2001

Seasons			1999/2000			2000/2001		
Treatments			N	P	K	N	P	K
Organic manure rates	Mineral nitrogen rates	Biofertilizer inoculation		%			%	
O_0			2.93 # A	0.26 A	2.27 A	2.70 A	0.28 A	2.20 A
O_1			2.92 A	0.28 A	2.25 A	2.78 A	0.29 A	1.93 A
	N_0		2.62 C	0.24 B	1.90 C	2.30 B	0.25 AB	1.83 B
	N_1		3.26 A	0.32 A	2.58 A	2.90 A	0.32 A	2.32 A
	N_2		2.91 B	0.25 B	2.31 B	3.02 A	0.30 A	2.05 AB
		B_0	2.95 A	0.26 A	2.25 A	2.74 A	0.30 A	2.05 A
		B_1	2.91 A	0.28 A	2.27 A	2.74 A	0.27 A	2.11 A
First-order interactions								
	O x N		*N.S	N.S	N.S	N.S	N.S	N.S
	O x B		N.S	N.S	N.S	N.S	N.S	N.S
	N x B		N.S	N.S	N.S	N.S	N.S	N.S
Second-order interactions								
	O x N x B		N.S	N.S	N.S	N.S	N.S	N.S

Values followed by the same letter (s), within a comparable group of means, are not significantly differ, using revised L.S.D. test at 0.05 level.

* N.S.= not significant at 0.05 level.

[x] Organic manure rates (m^3 fad^{-1}) : O_0 = without organic manure (control) and O_1 = 25.

[y] Mineral nitrogen rates (kg. N.fad^{-1}) : N_0 = without nitrogen (control) , N_1 = 20 and N_2 = 40.

[z] Biofertilizer inoculation: B_0 = Uninoculated and B_1 = inoculated with *Rhizobium* .

seed inoculation with *Rhizobium*. On the contrary, Merghany (1999) stated that the highest values of N, P and K contents in snap bean leaves were obtained from the inoculated plants, compared with the uninoculated ones.

Concerning the effects of the different treatment combinations on the concentrations of N, P and K in pea leaves, the results illustrated that the differences were not high enough to be significant.

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تأثيرات إضافة السماد العضوي والنيتروجين المعدني والسماد الحيوي علي النمو الخضري والتركيب الكيماوي للبسلة

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# قسم البساتين - كلية الزراعة - دمنهور - جامعة الإسكندرية

نفذت تجربتين حقليتين في الموسمين الشتويين لعامي ١٩٩٩/٢٠٠٠ ، ٢٠٠٠/٢٠٠١ في مزرعة محطة التجارب بكلية الزراعة - جامعة الإسكندرية ، بهدف دراسة تأثير مستوي إضافة كل من السماد العضوي " سماد الماشية" (صفر، ٢٥كجم / للفدان). والنيتروجين المعدني (صفر ،٢٠ ، ٤٠ كجم ن / فدان) والسماد الحيوي (بدون تلقيح وتلقيح ببكتيريا الرايزوبيم) وتتبع تأثيرات التداخل بين مستويات العوامل الثلاث علي بعض صفات النمو الخضري (ارتفاع النبات وعدد الأوراق والفروع للنبات، الوزن الطازج والجاف للنبات) وكذلك تقدير محتوي الأوراق من عناصر النيتروجين والفوسفور والبوتاسيوم. ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي :

١- أدي استخدام السماد العضوي بمعدل ٢٥ م٣ / فدان إلي زيادة معنوية في كل الصفات موضع الدراسة.

٢- أدت إضافة السماد المعدني النيتروجيني بمعدل ٢٠ كجم ن/ فدان إلي زيادة معنوية في معظم صفات النمو الخضري مقارنة باستخدام معدل ٤٠ كجم ن/ فدان أو معاملة المقارنة (الغير معامل) .

٣- أظهر تلقيح بذور البسلة بلقاح الرايزوبيم زيادة معنوية لمعظم الصفات الخضرية للنباتات .

٤- أظهرت نتائج تفاعلات الدرجة الأولي التالية : ٢٥ م٣/ فدان سماد ماشية +٢٠ كجم ن معدني/ فدان ، ٢٥ م٣ سماد ماشية/فدان+ تلقيح البذور ببكتيريا الرايزوبيم، ٢٠ كجم ن معدني للفدان + تلقيح البذور ببكتيريا الرايزوبيم تأثيرات إيجابية معنوية علي كل صفات النمو الخضري المدروسة .

٥- بالنسبة لتأثيرات التفاعل من الدرجة الثانية أظهرت النتائج أن استخدام السماد العضوي بمعدل ٢٥ م٣/ فدان + ٢٠ كجم ن/ فدان + التلقيح البكتيري بالرايزوبيم هي أفضل معاملة متداخلة بين العوامل المدروسة و التي أثرت معنويا علي ارتفاع النبات، عدد الأوراق والفروع للنبات، الوزن الطازج والجاف للنبات.

٦- أوضحت النتائج أن محتوي أوراق البسلة من عناصر النيتروجين والفوسفور والبوتاسيوم قد تأثر إيجابيا بإضافة التسميد النيتروجيني فقط، وعلي العكس من ذلك لم تؤثر معاملات التسميد العضوي أو الحيوي أو التداخلات بين مستويات المعاملات المختلفة علي محتوي الأوراق من هذه العناصر .